



Schools, Skills, and Synapses

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Argument

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Many major economic and social problems such as crime, teenage pregnancy, dropping out of high school and adverse health conditions can be traced to low levels of skill and ability in society.

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Need to recognize the multiplicity of abilities.

Current public policy discussions focus on promoting and measuring cognitive ability through IQ and achievement tests.

For example, in the U.S. the accountability standards in the No Child Left Behind Act concentrate attention on achievement test scores, not evaluating a range of other factors that promote success in school and life.

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Cognitive abilities are important determinants of socioeconomic success.

So are socioemotional skills, physical and mental health, perseverance, attention, motivation, and self confidence.

They contribute to performance in society at large and even help determine scores on the tests that are used to monitor cognitive achievement.

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Ability gaps — cognitive and noncognitive — between the advantaged and disadvantaged open up early in the lives of children.

Family environments of young children are major predictors of cognitive and socioemotional abilities, as well as crime, health and obesity.

This observation is a major source of concern because family environments in the U.S. the U.K. and Ireland and many other countries around the world have deteriorated over the past 40 years.

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Experimental evidence on the effectiveness of early interventions in disadvantaged families is consistent in a positive way with a large body of non-experimental evidence that adverse family environments, especially adverse parenting, substantially impair child outcomes.

If society intervenes early enough, it can raise cognitive and socioemotional abilities and the health of disadvantaged children.

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Socioemotional abilities are malleable, and neglected in most cognitively oriented intervention studies.

Early interventions promote schooling, reduce crime, foster workforce productivity and reduce teenage pregnancy.

These interventions are estimated to have high benefit-cost ratios and rates of return.

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As programs are currently configured, early interventions have much higher economic returns than later interventions focused on promoting cognitive factors such as reduced pupil-teacher ratios, public job training, convict rehabilitation programs, adult literacy programs, tuition subsidies or expenditure on police.

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Life cycle skill formation is dynamic in nature. Skill begets skill; motivation begets motivation. If a child is not motivated and stimulated to learn and engage early on in life, the more likely it is that when the child becomes an adult, it will fail in social and economic life.

The longer society waits to intervene in the life cycle of a disadvantaged child, the more costly it is to remediate disadvantage. Similar dynamics are at work in creating child health and mental health.

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A major refocus of policy is required to understand the life cycle of skill and health formation and the importance of the early years in creating inequality in America, and in producing skills for the workforce.

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Consider One Aspect of Increasing Polarization in American Society

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Schooling attainment rates.

The U.S. high school dropout rate is increasing.

More youth going to college.

This trend is masked by official statistics.

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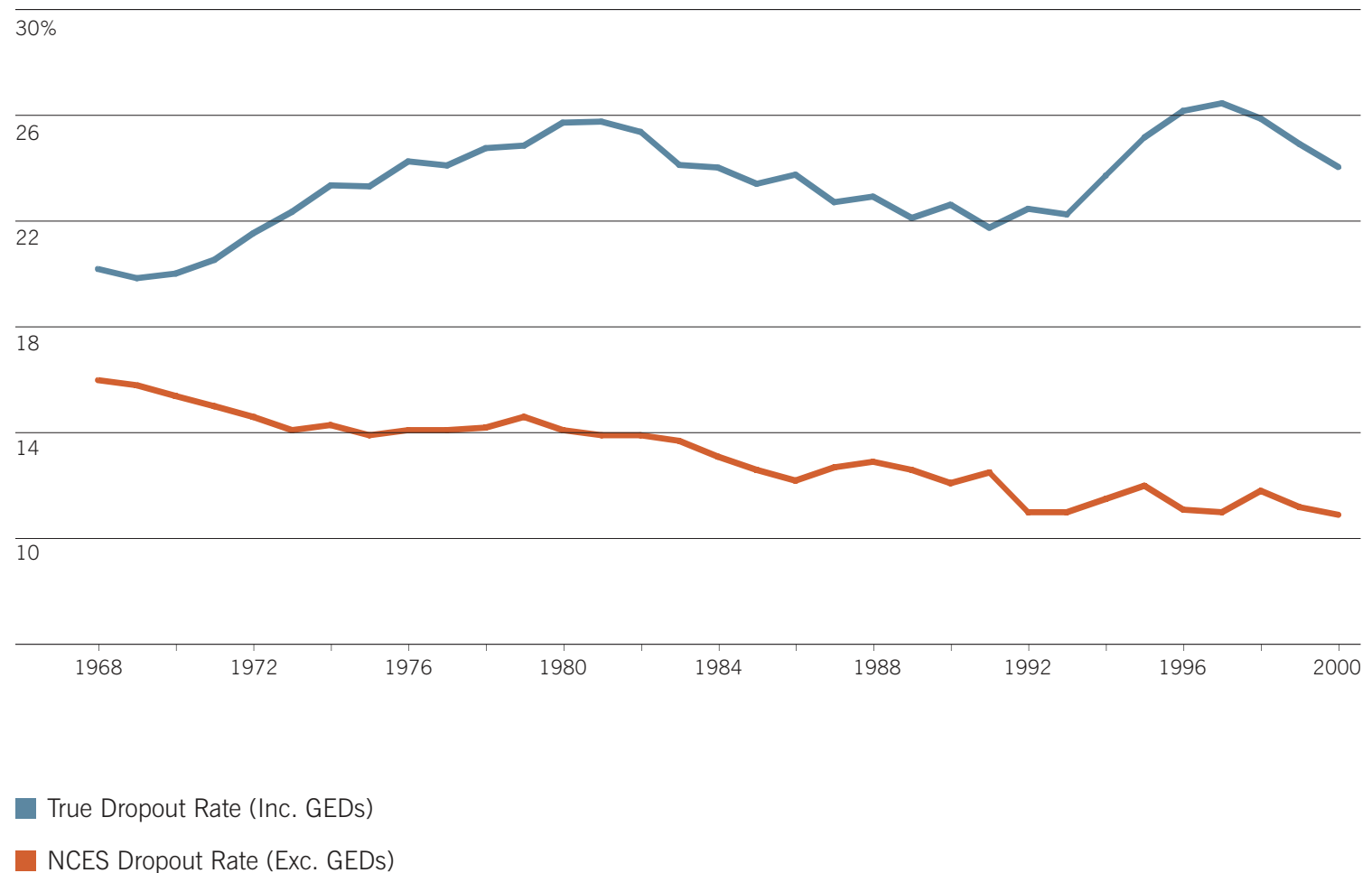
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Figure 1: True Dropout Rate vs. NCES Status Dropout Rate, Males and Females 1968 – 2000



Source: Heckman and LaFontaine (2007).

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Consider One Aspect of Increasing Polarization in American Society

High school graduation as a source of growth in educational attainment diminishes and turns negative for more recent cohorts of Americans.

The decline in high school graduation rates since 1970 (for cohorts born after 1950) has flattened college attendance and completion rates as well as growth in the skill level of the U.S. workforce.

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Annual growth in labor productivity is slowed by 0.17 to 0.35 percent per year by the trends that reduce the growth of labor force quality.

America will produce less than half of the growth in college graduates than it produced in the previous 20 years despite the growth in the size of the total population.

Level of skill in the U.S. population is low.

Table 2: Educational Characteristics of the Labor Force Aged 25 and Over, 1980, 2000, 2020

Education	Labor Force 1980	Growth 1980 – 2000	Labor Force 2000	Growth 2000 – 2020	Labor Force in 2020
Less than High School	17.3	-5.3	12.0	0.9	12.9
High School Only	31.5	6.3	37.8	3.8	41.6
Some Schooling Beyond	—	—	—	—	—
High School	13.8	19.1	32.9	6.2	39.1
College Degree or More	17.3	18.5	35.8	7.7	43.5
Total	79.8	38.7	118.5	18.6	137.1
% with College Degree	21.6%		30.2%		31.7%

**Assumes that subsequent cohorts have same education at age 25 as the cohort age 25 in 2000.*

Source: Ellwood (2001).

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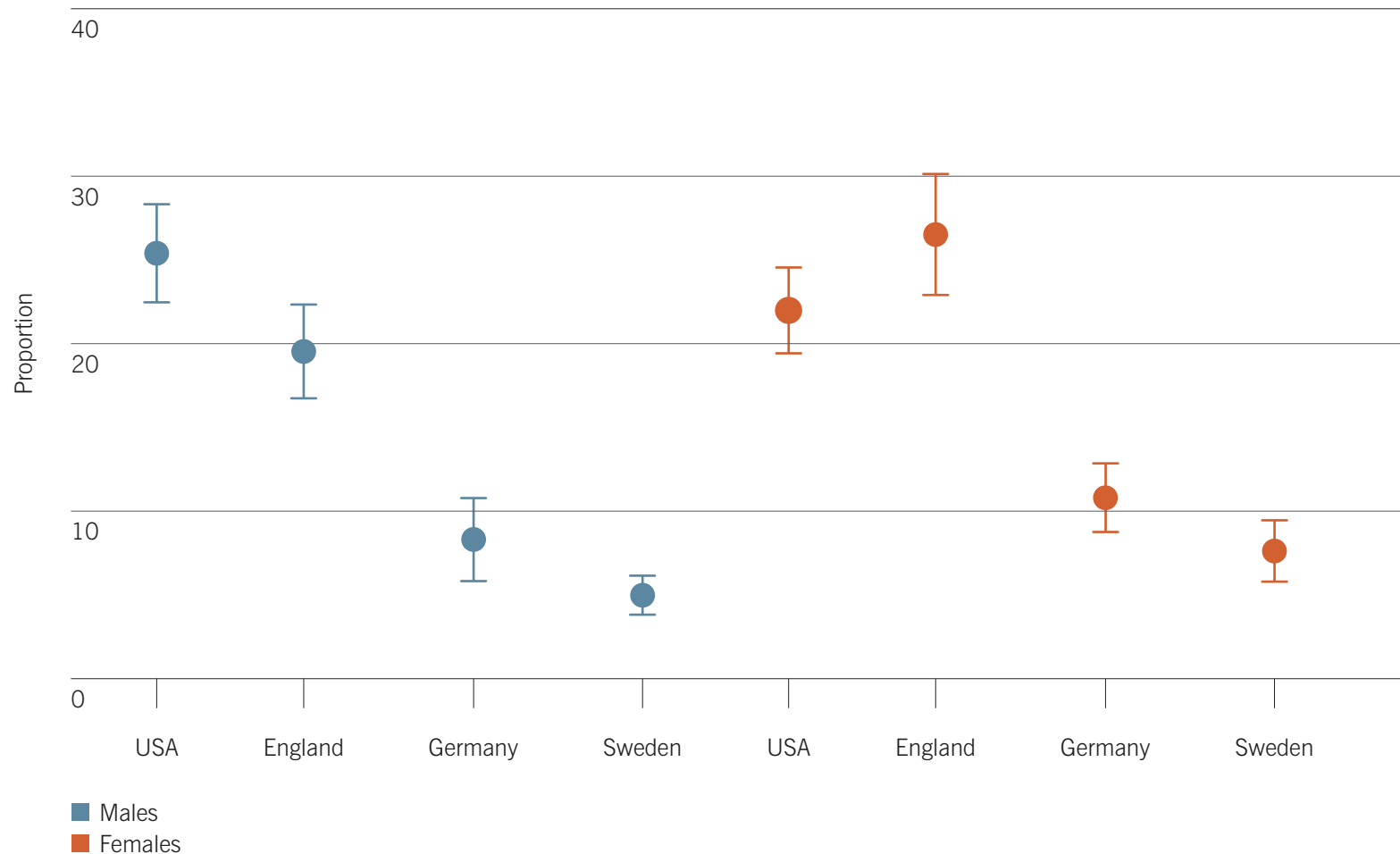
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Figure 7: Percentage of Each Gender Who Perform At Level 1 on the IALS Document Literacy Scale



Note: The scale scores were grouped into five levels of increasing difficulty, with Level 1 representing functional illiteracy. Levels 4 and 5 were combined. The sample is restricted to adults who are between 16 and 65 years of age at the time of the survey (1994 for the U.S. and Germany, 1996 for the U.K., and 1994–1995 for Sweden). Standard errors are calculated using the methodology described in the International Adult Literacy Survey Microdata User's Guide (2002).

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What forces produce these low levels and adverse trends?

Are the public schools mainly responsible?

Can we look to school reform to fix the problem?

Are higher college tuition costs to blame?

The answer is “No” to all of these questions.

Consider One Aspect of Increasing Polarization in American Society

Contrary to prevailing views, accounting for the ability of a child at the age college decisions are made, tuition costs and schooling quality explain a trivial fraction of the gaps in educational attainment by socioeconomic status.

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The Importance of Cognitive and Noncognitive Skills

The Importance of Cognitive and Noncognitive Skills

An emerging body of evidence shows that, as is intuitively obvious and commonsensical, much more than smarts are required.

- Motivation
- Sociability; ability to work with others
- Attention
- Self Regulation
- Self Esteem
- Time Preference
- Health and Mental Health

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The Importance of Cognitive and Noncognitive Skills

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The GED program is a second chance program given to secondary school dropouts.

Participation in the GED program is growing. Currently 20% of U.S. high school “graduates” are dropouts who exam certify.

The Importance of Cognitive and Noncognitive Skills

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GEDs are required to pass a test of cognitive abilities.

Level relatively low — at the grade 8 to grade 10 level.

Test is successful in its own terms.

Density of Age Adjusted AFQT Scores, GED Recipients and High School Graduates with Twelve Years of Schooling

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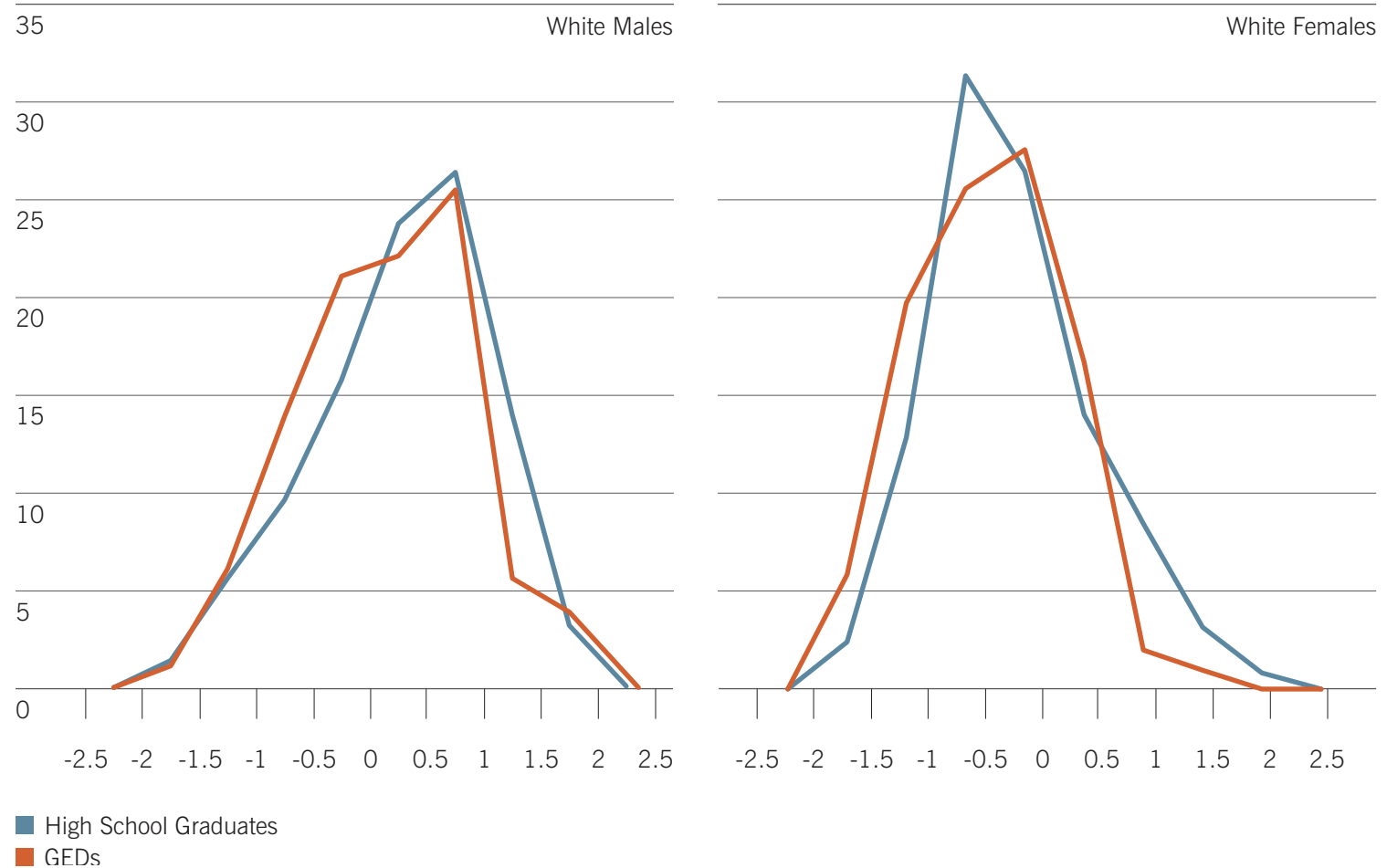
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Source: Heckman, Hsee and Rubinstein (2001)

Density of Age Adjusted AFQT Scores, GED Recipients and High School Graduates with Twelve Years of Schooling

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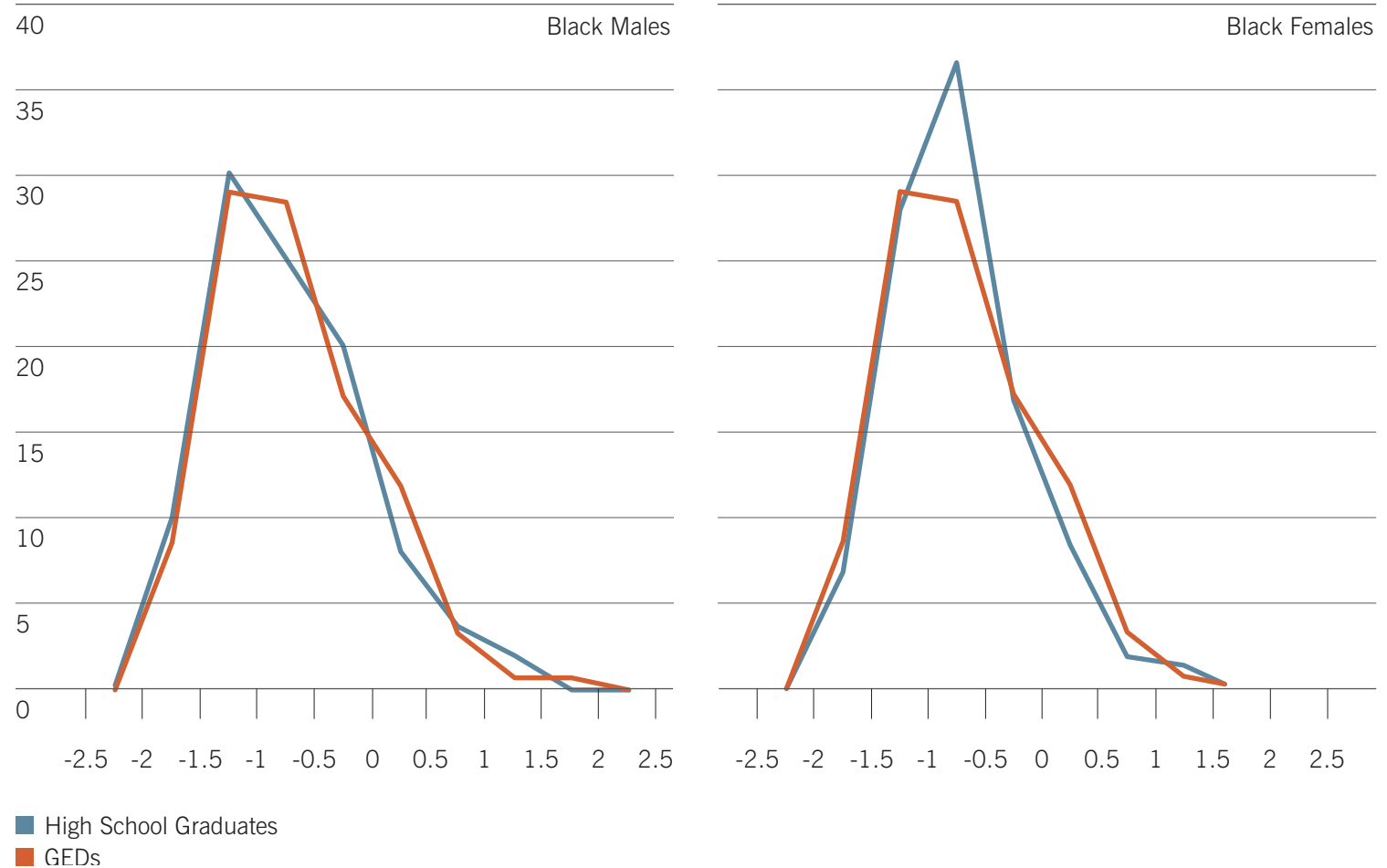
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Source: Heckman, Hsee and Rubinstein (2001)



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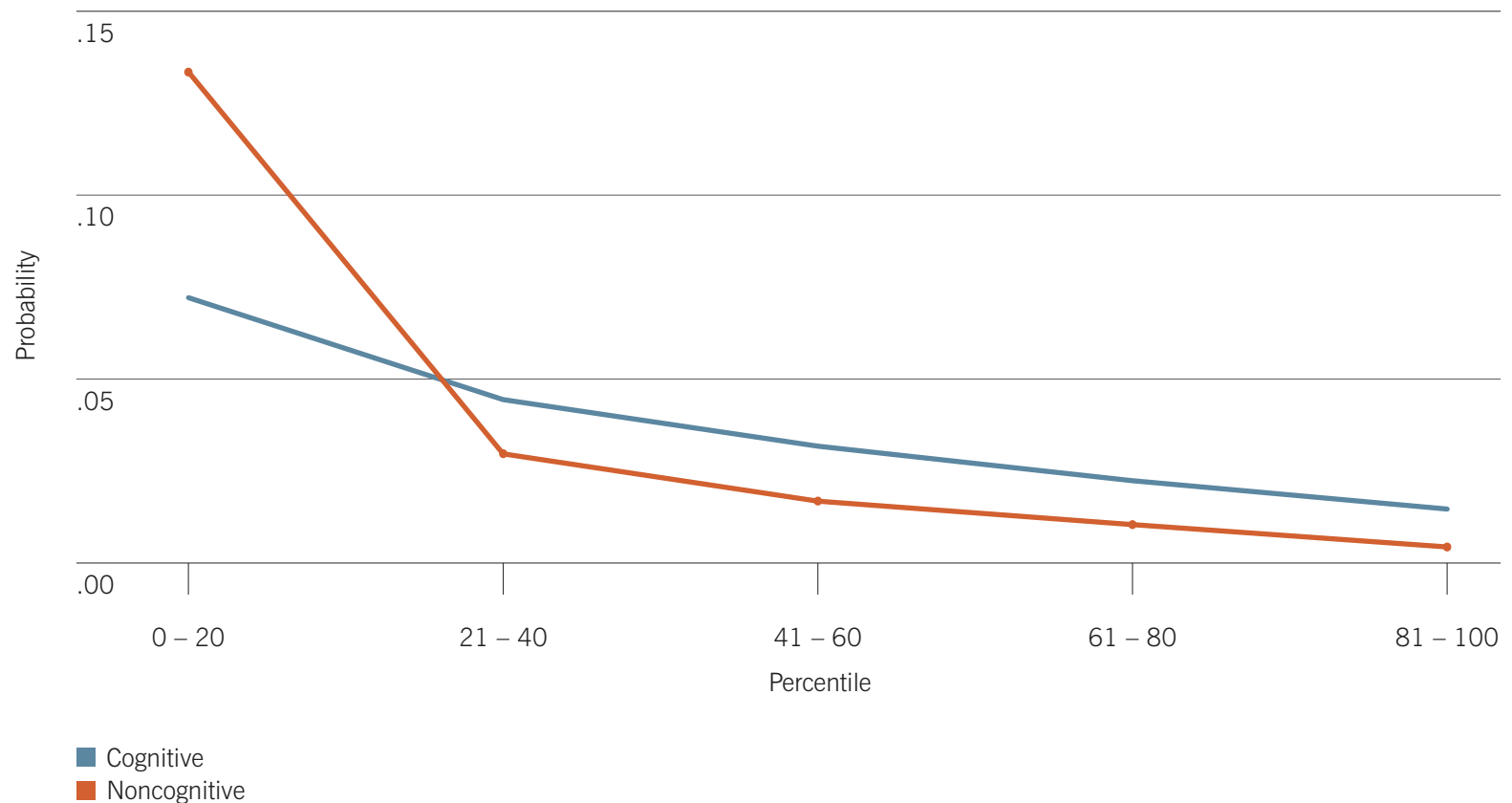
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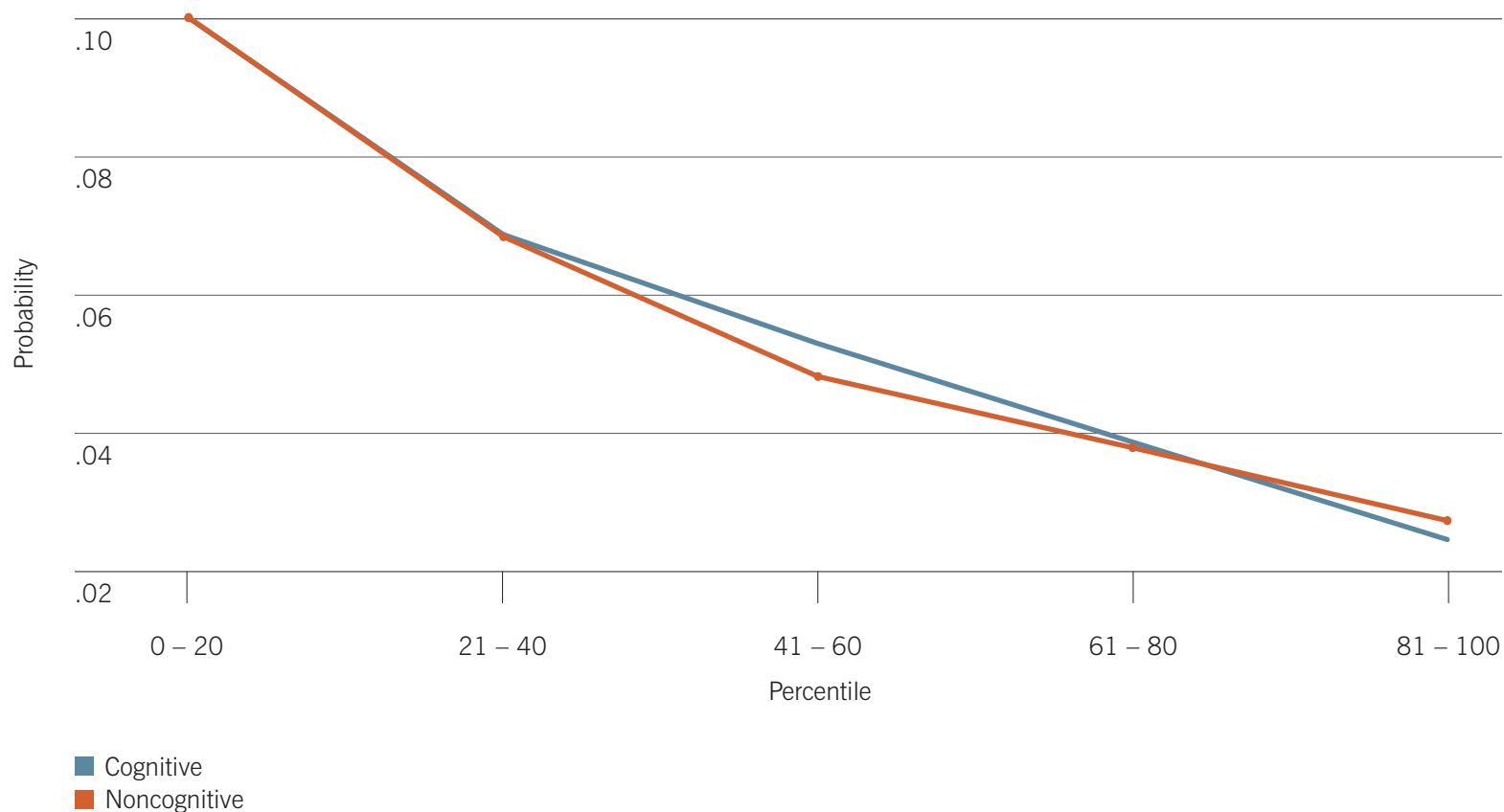
Ever Been in Jail by Age 30, By Ability (Males)



Note: This figure plots the probability of a given behavior associated with moving up in one ability distribution for someone after integrating out the other distribution. For example, the lines with markers show the effect of increasing noncognitive ability after integrating the cognitive ability.

Source: Heckman, Stixrud, and Urzua (2006).

Probability of Being Single With Children (Females)

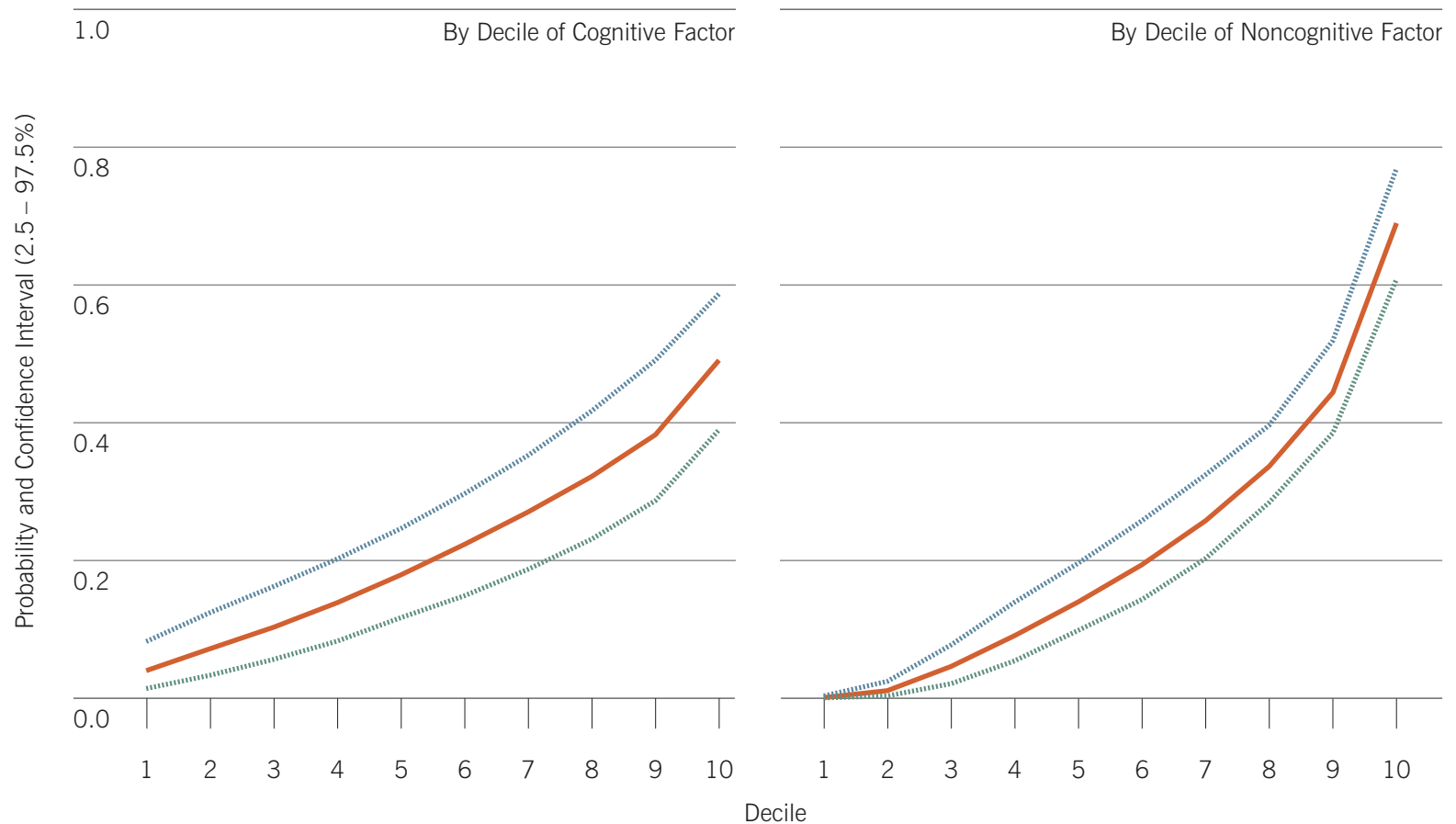


Note: This figure plots the probability of a given behavior associated with moving up in one ability distribution for someone after integrating out the other distribution. For example, the lines with markers show the effect of increasing noncognitive ability after integrating the cognitive ability.

Source: Heckman, Stixrud, and Urzua (2006).

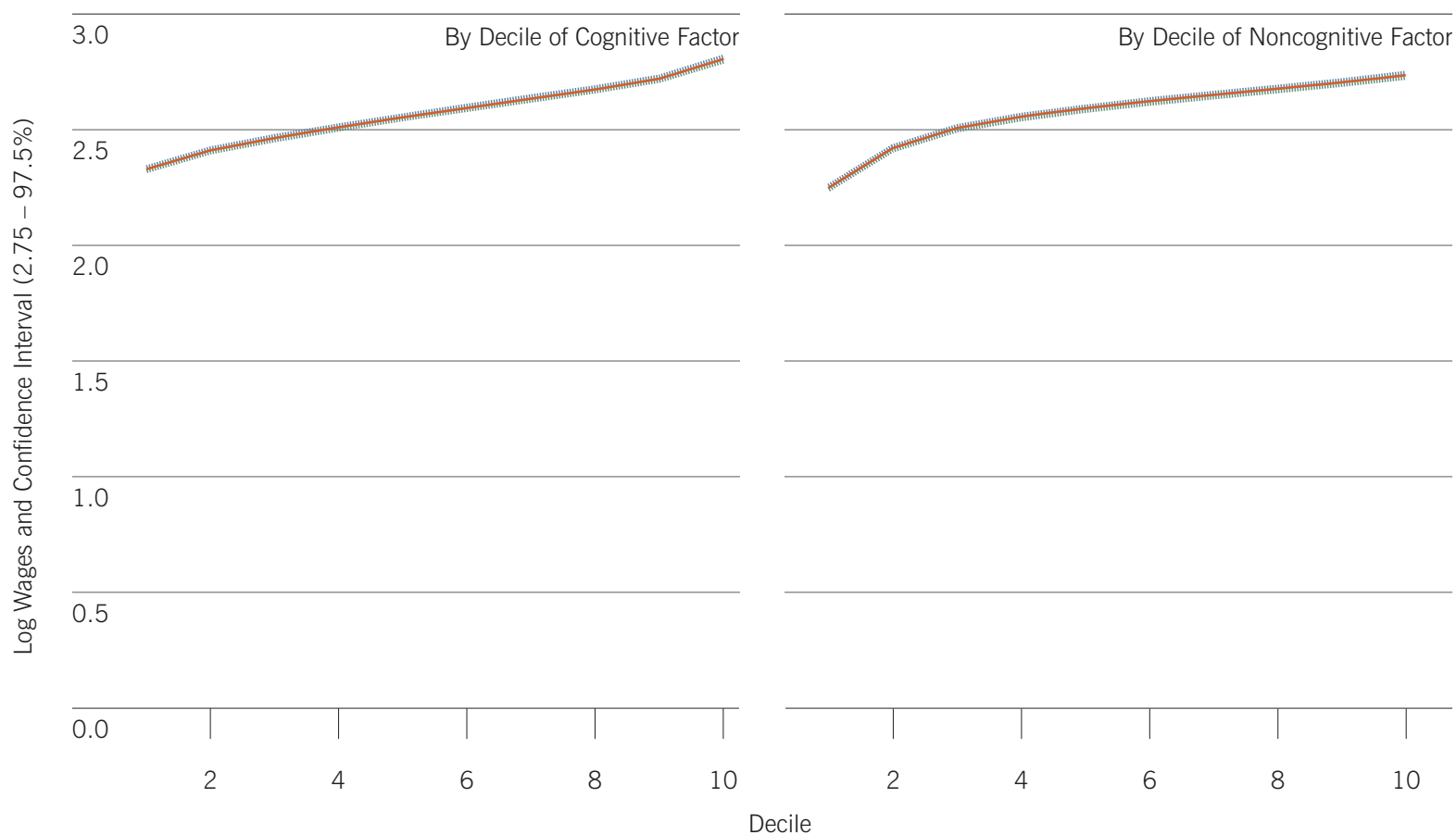
Probability of Being a 4-year College Graduate by Age 30 (Males)

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Notes: The data are simulated from the estimates of the model and our NLSY79 sample. We use the standard convention that higher deciles are associated with higher values of the variable. The confidence intervals are computed using bootstrapping (200 draws).

Mean Log Wages by Age 30 (Males)



Notes: The data are simulated from the estimates of the model and our NLSY79 sample. We use the standard convention that higher deciles are associated with higher values of the variable. The confidence intervals are computed using bootstrapping (50 draws).

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Controlling for ability measured at age 18, minorities are *more likely* to attend college than others despite their lower family incomes (Cameron and Heckman, 2001).

Can ability differences explain racial-ethnic schooling gaps?

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High School Completion Gap

	White-Black Gap	White-Hispanic Gap
Actual White-Minority Gap	.06 (.01)	.14 (.02)
Ability Adjusted Gap	-.14 (.03)	-.12 (.04)

Source: Cameron and Heckman (2001)

Can ability differences explain racial-ethnic schooling gaps?

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College Entry Probabilities Given High School Completion

	White-Black Gap	White-Hispanic Gap
Actual White-Minority Gap	.11 (.02)	.07 (.02)
Ability Adjusted Gap	-.14 (.02)	-.14 (.04)

Source: Cameron and Heckman (2001)

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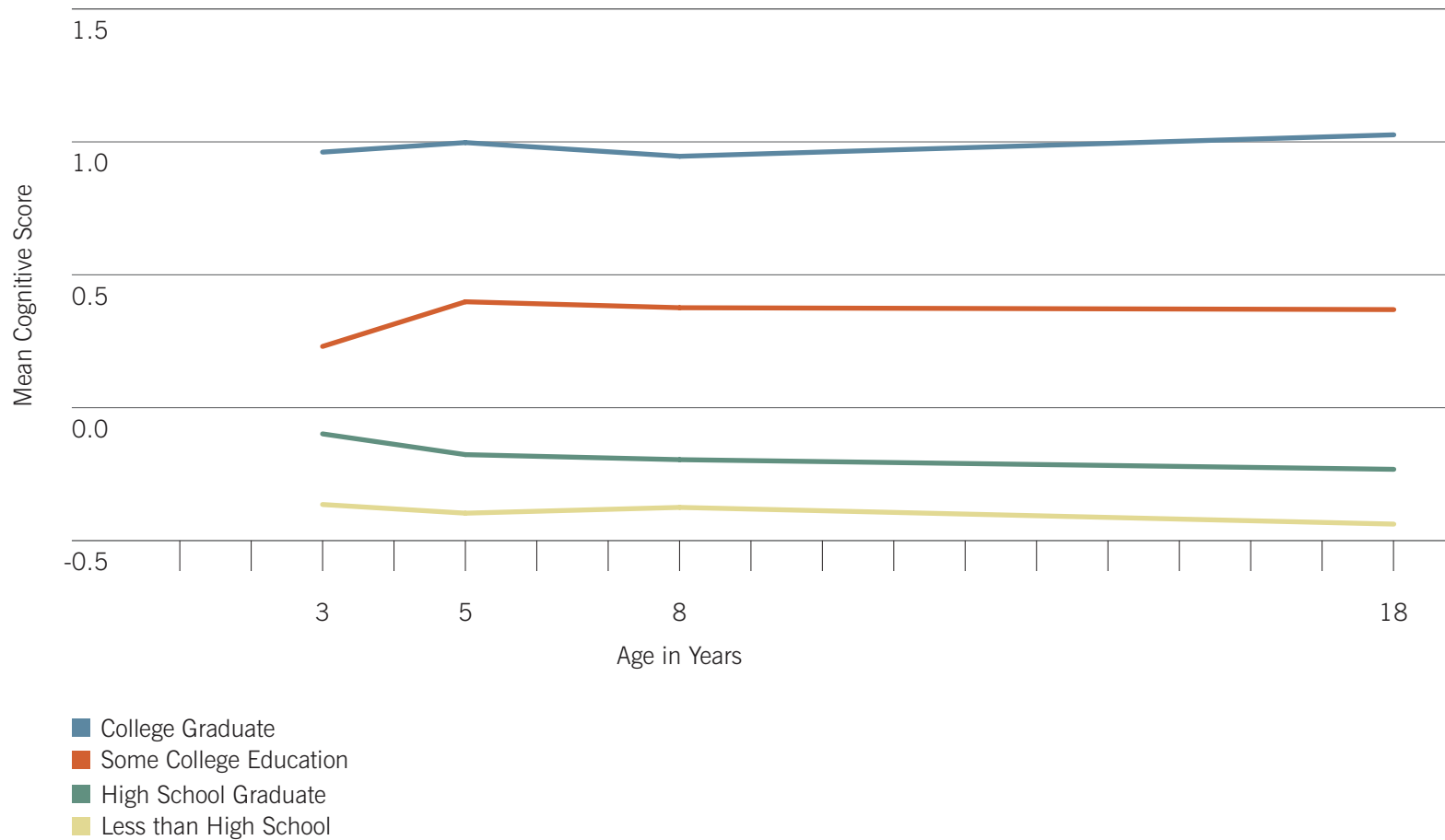
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Gaps in the abilities that play such an important role in determining diverse adult labor market and health outcomes open up early across income groups.

Trend in Mean Cognitive Score by Maternal Education



Each score standardized within observed sample. Using all observations and assuming data missing at random.

Source: Brooks-Gunn et al. (2006).

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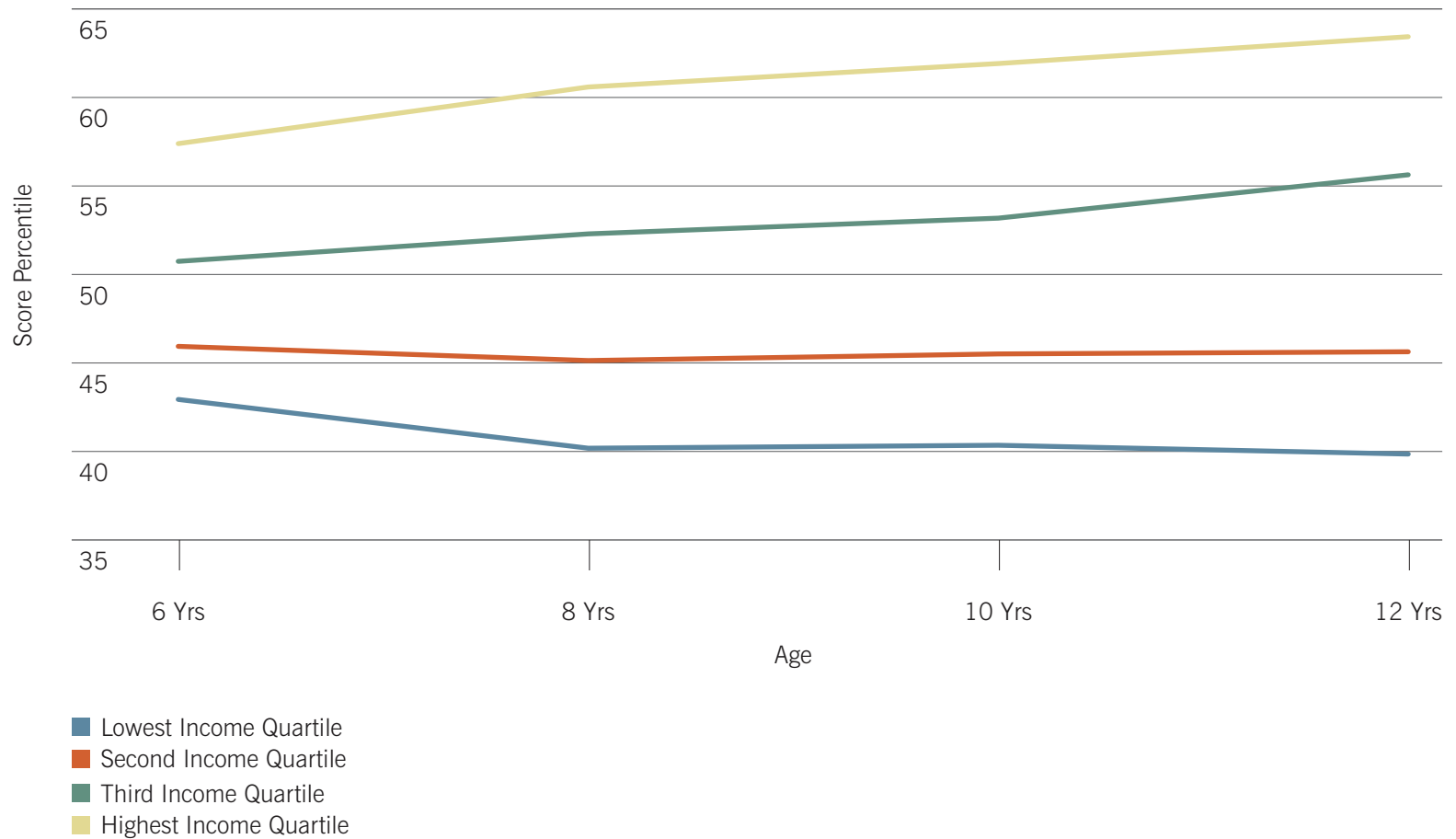
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Figure D1a. Average Percentile Rank on PIAT-Math Score, by Income Quartile



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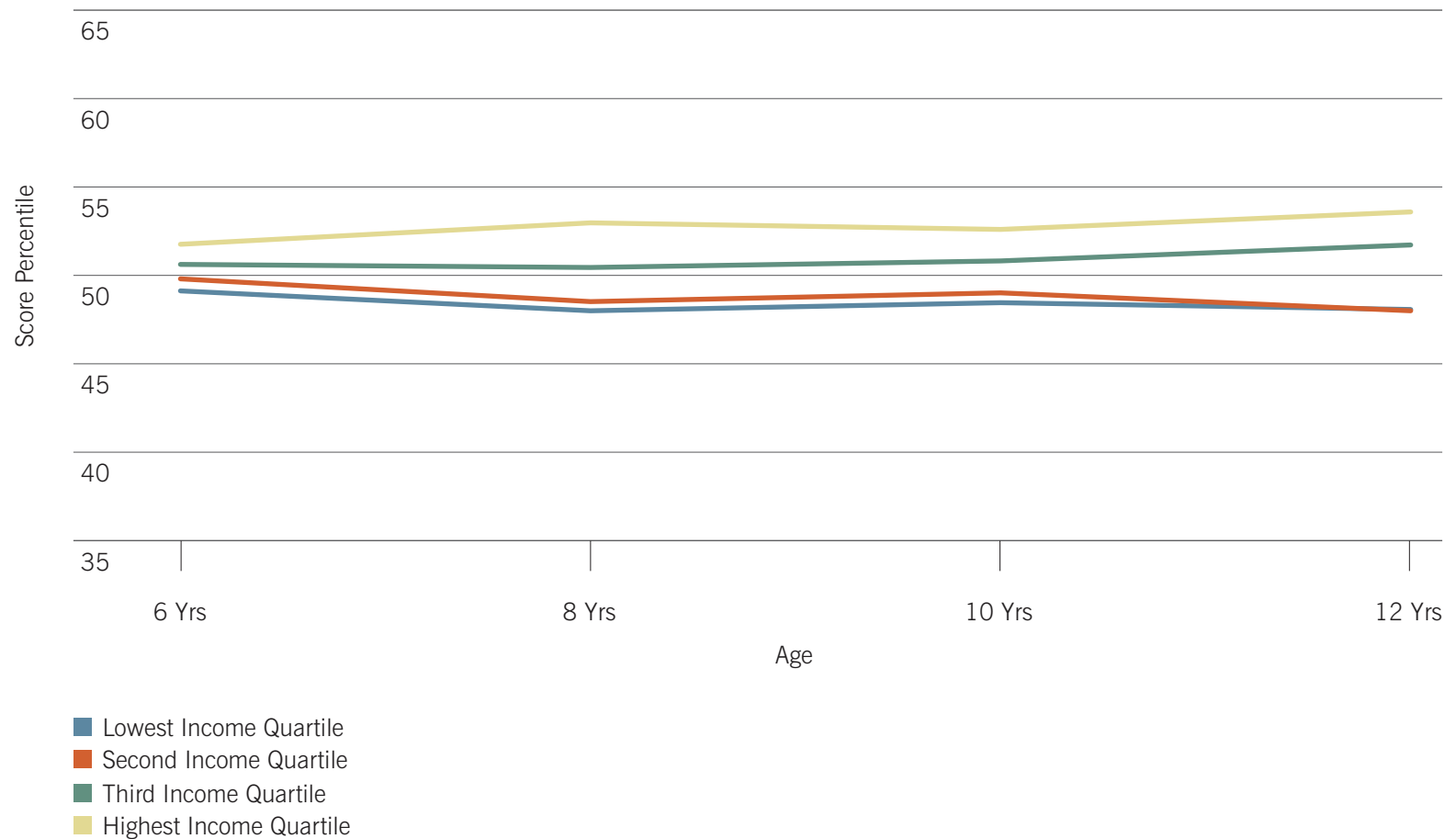
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Figure D1b. Adjusted Average PIAT-Math Score Percentiles, by Income Quartile



**Residualized on maternal education, maternal AFQT (corrected for the effect of schooling) and broken home at each age.*

Figure D3a. Average Percentile Rank on Anti-Social Behavior Score, by Income Quartile

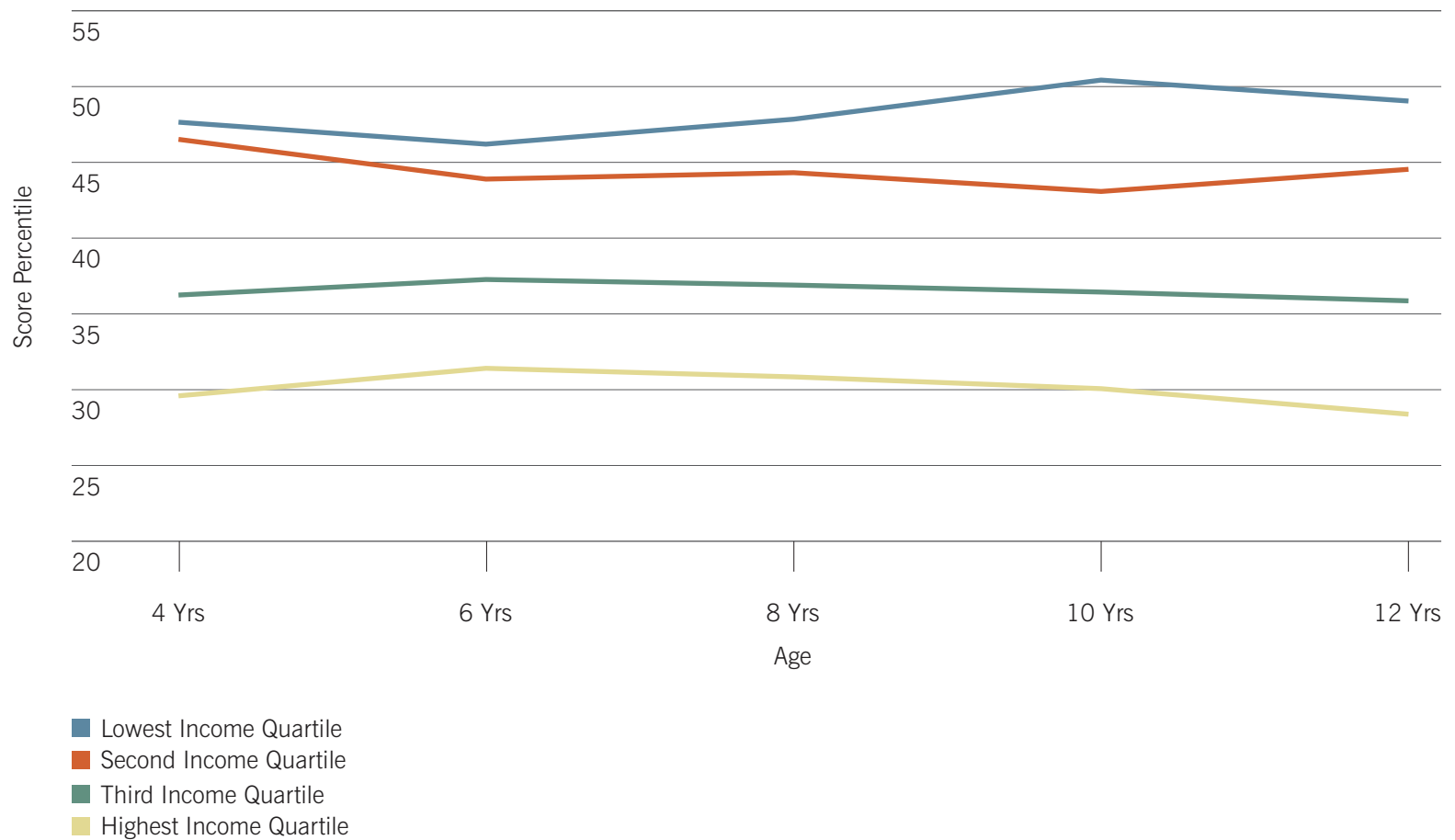
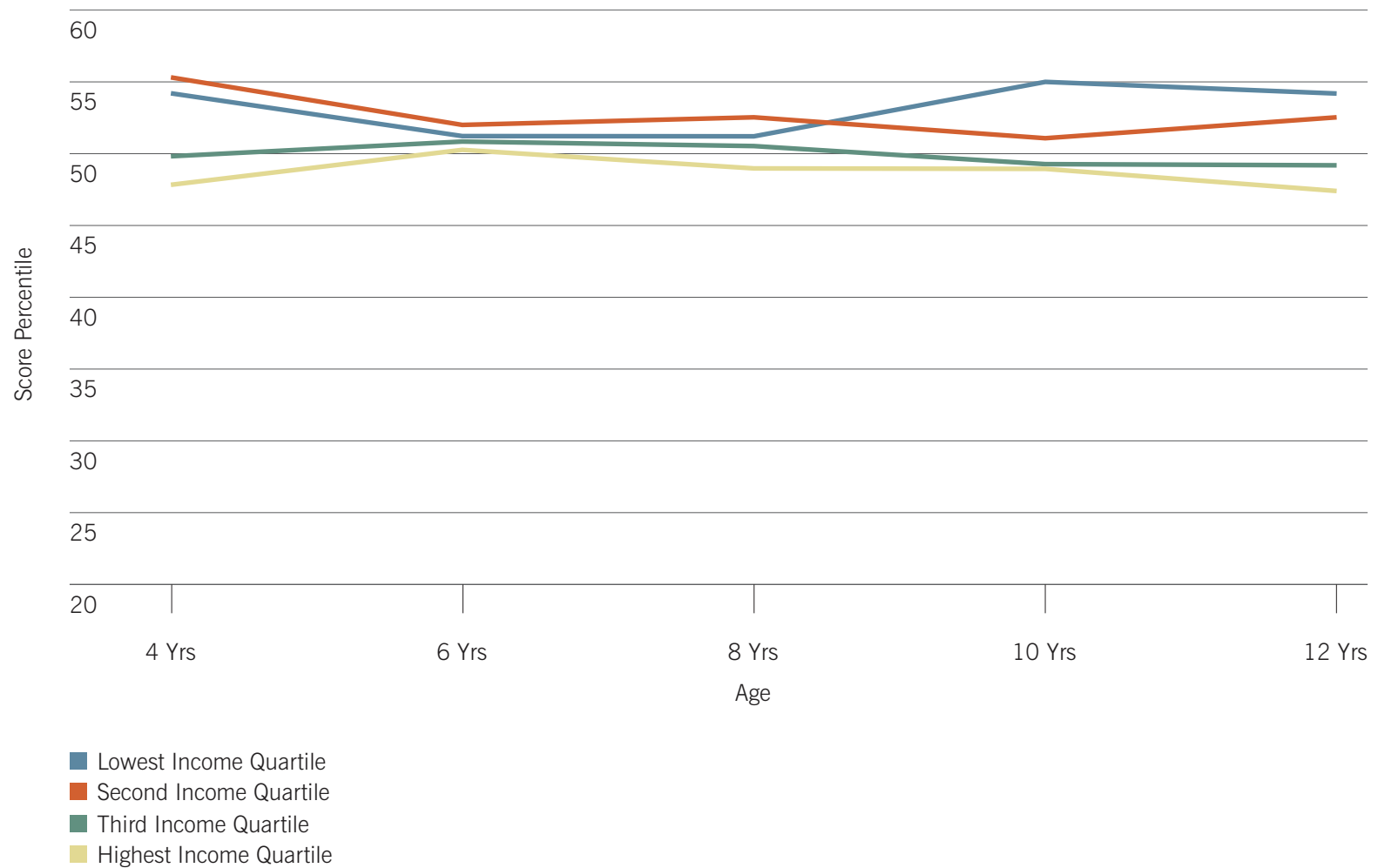


Figure D3b. Adjusted Average Anti-Social Behavior Score Percentile, by Income Quartile



**Residualized on maternal education, maternal AFQT (corrected for the effect of schooling) and broken home at each age.*

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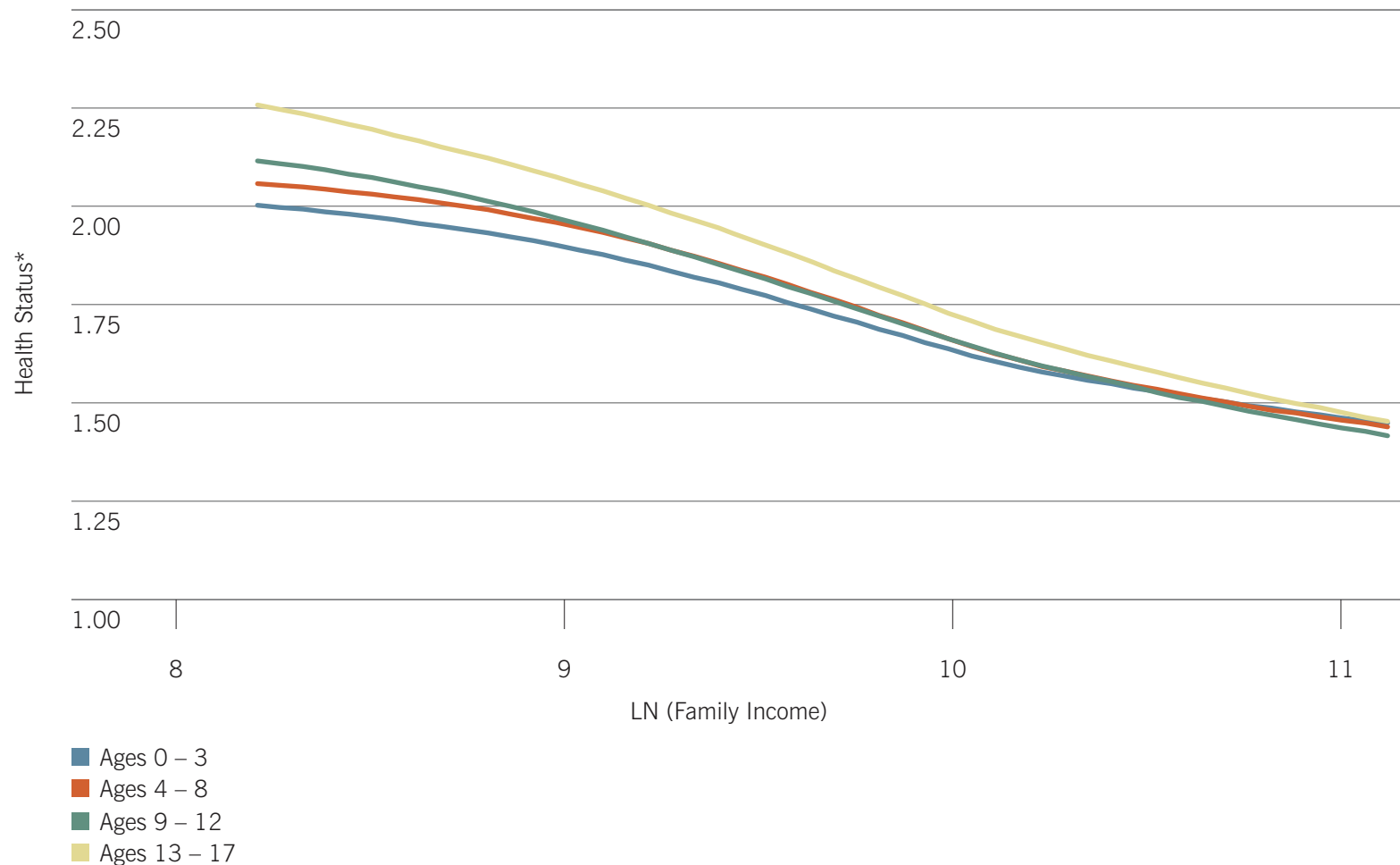
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Gaps also emerge in health. These appear to diverge with age, at least in the U.S.

Similar gaps by age in the U.S., Canada, and United Kingdom

Health and Income For Children and Adults, U.S. National Health Interview Survey 1986 – 1995*



*(Scale ranges from 1 = Excellent to 5 = Poor)

* From Case, A., Lubotsky, D. & Paxson, C. (2002), *American Economic Review*, Vol. 92, 1308 – 1334.

Abilities and Outcomes

Gaps in cognitive and noncognitive skills of children have counterparts in gaps in family investments and environments.

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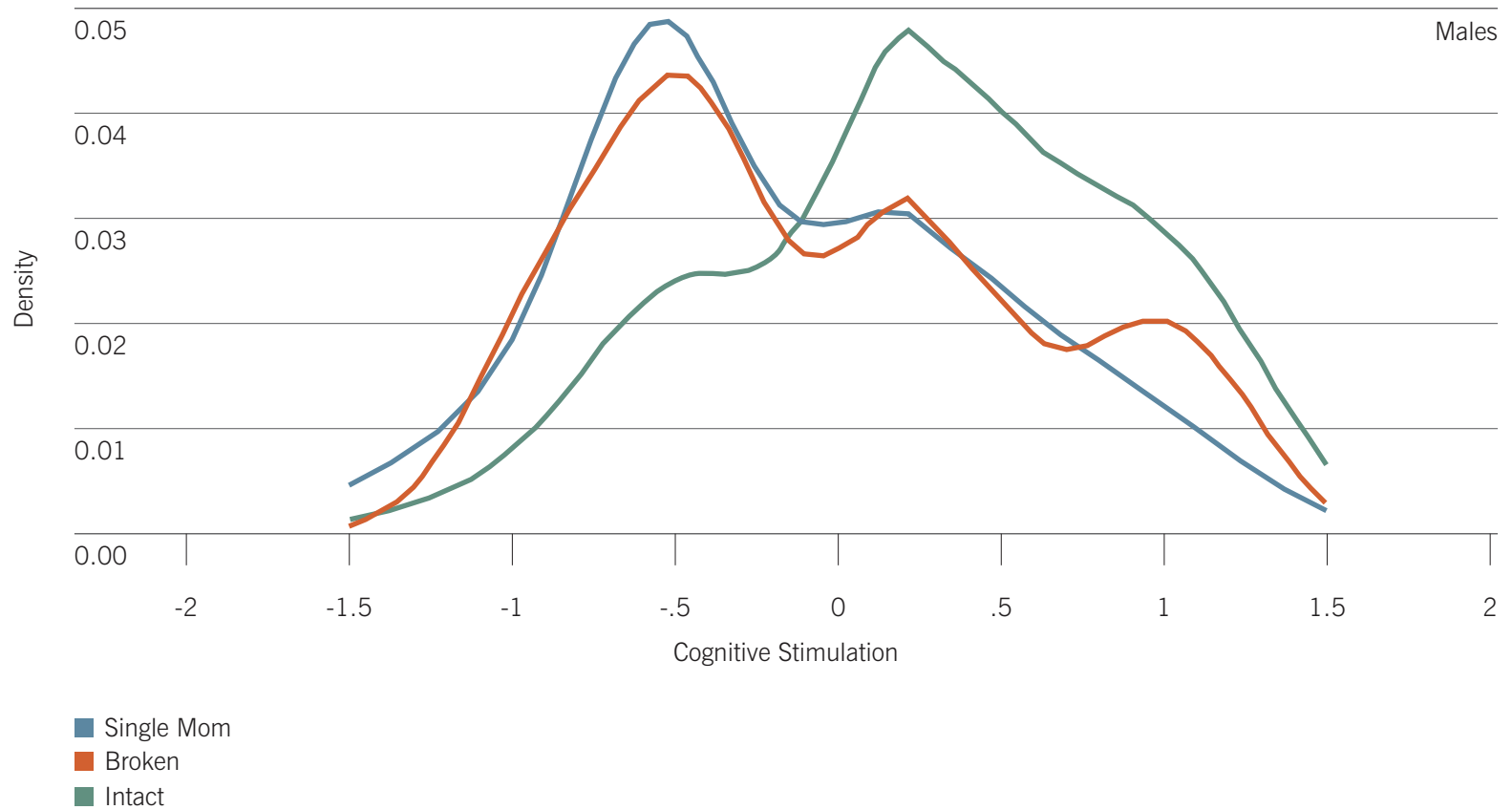
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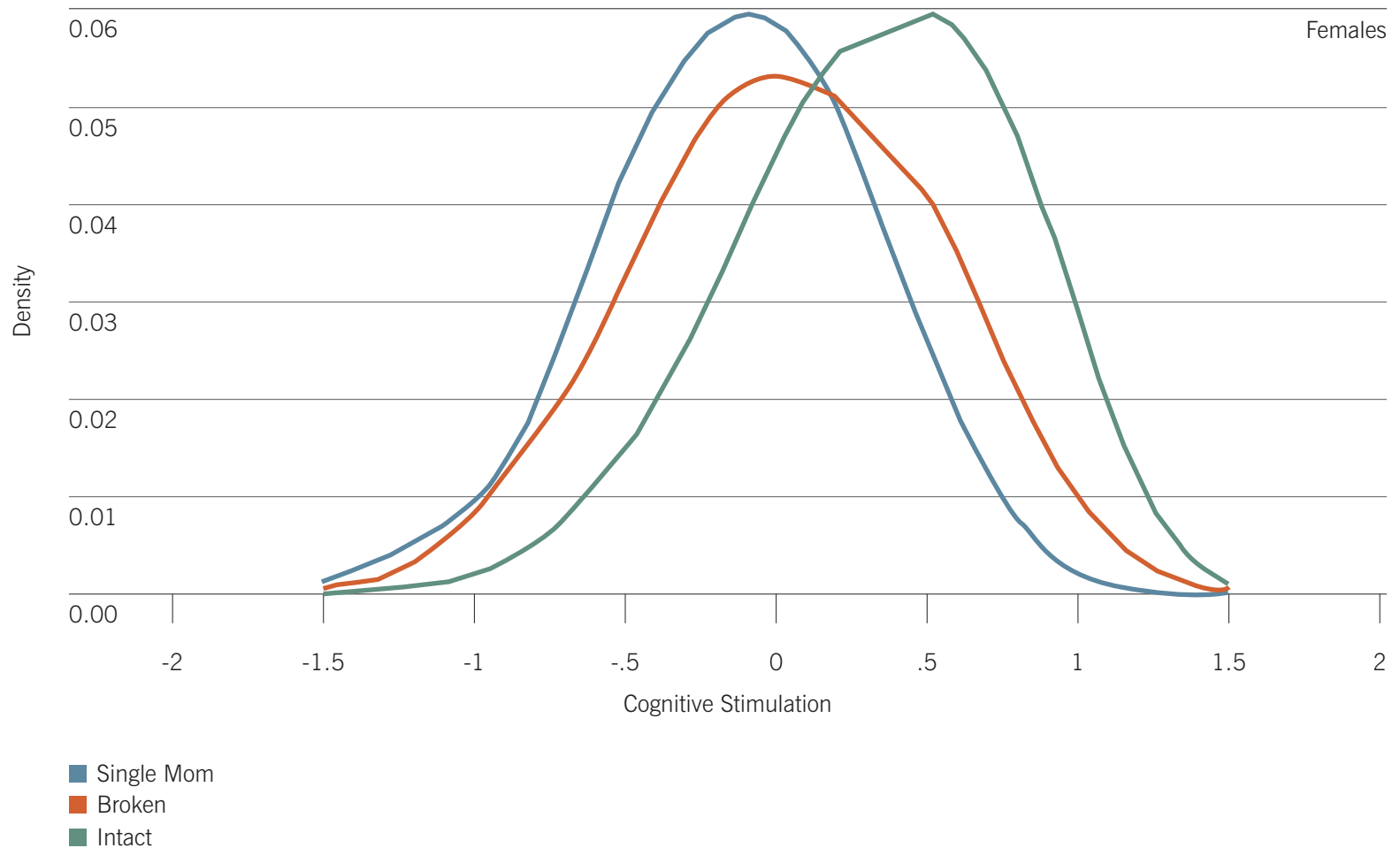
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Cognitive Stimulation: Age 0 – 2, White, by Family Type



Source: Seong Hyeok Moon (2008) analysis of CNLSY data

Cognitive Stimulation: Age 10 – 11, White, by Family Type



Source: Seong Hyeok Moon (2008) analysis of CNLSY data

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Family Environments

Percent of Children Under 18 Living with One Parent, By Marital Status of Single Parent

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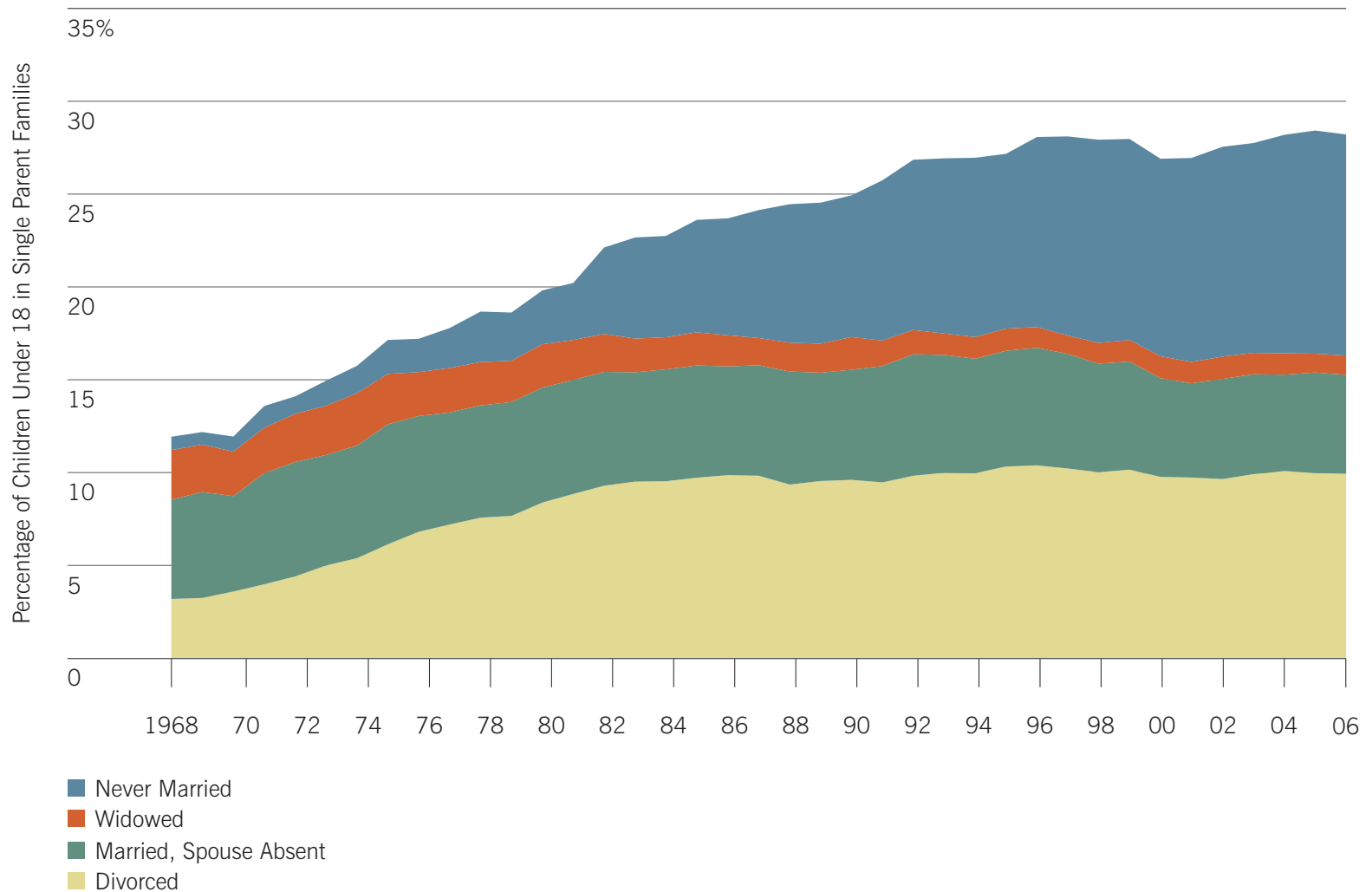
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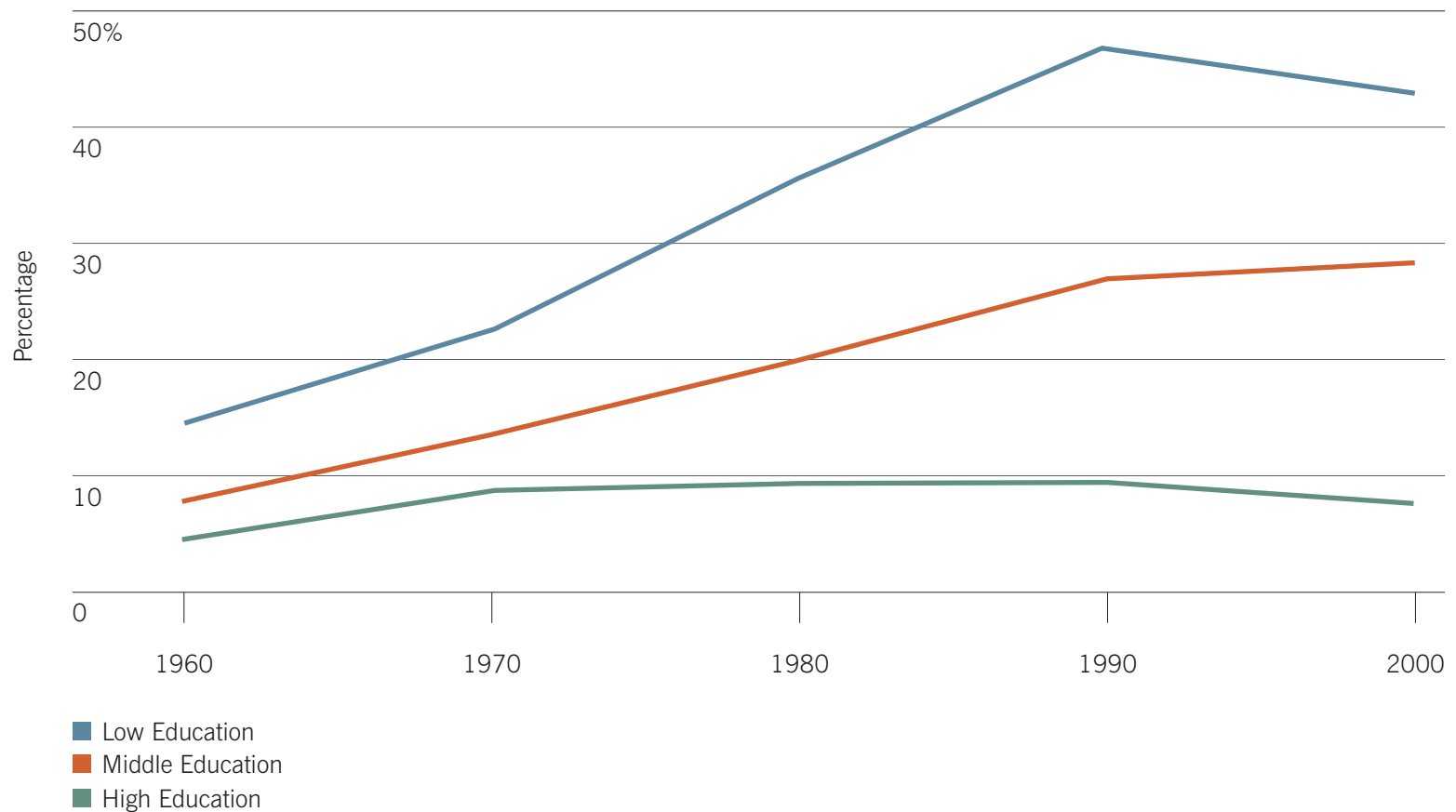
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Trends in Single Motherhood, 1960 to 2000



Note: Single motherhood is defined as not being married or not living with a spouse.

Source: PUMS (1960 – 2000).

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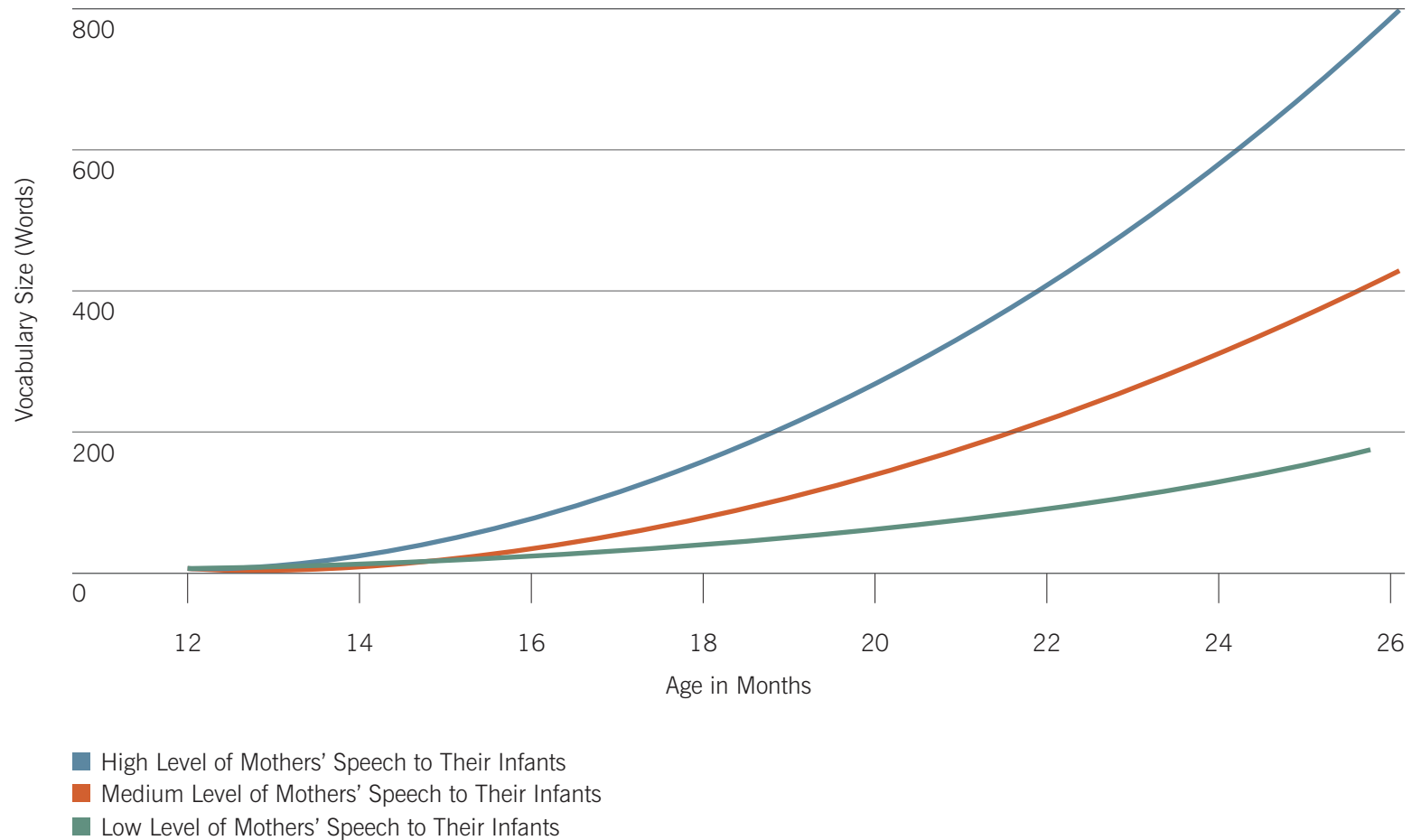
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Mothers' Speech and Child Vocabulary



Source: Huttenlocher et al. (1991)

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Gene- Environment Interactions

Methylation Patterns in Young and Old Twins

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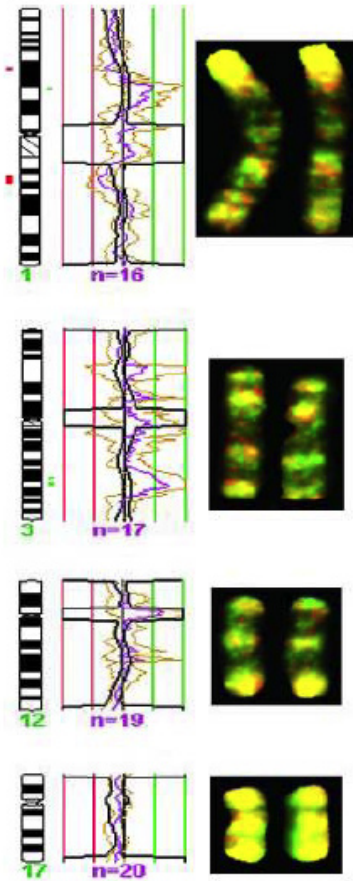
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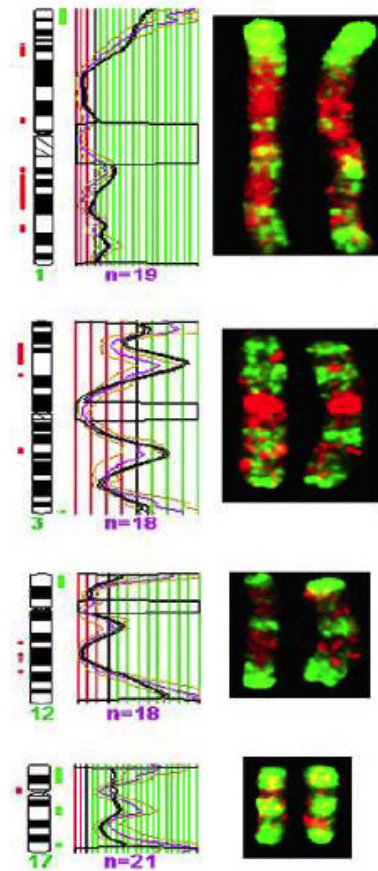
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3-year-old twins



50-year-old twins



Source: Fraga, Ballestar et. al. (2005)

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Examples of How Genes are Triggered by Environments

Childhood Maltreatment

Age 3 –11 in Dunedin Cohort

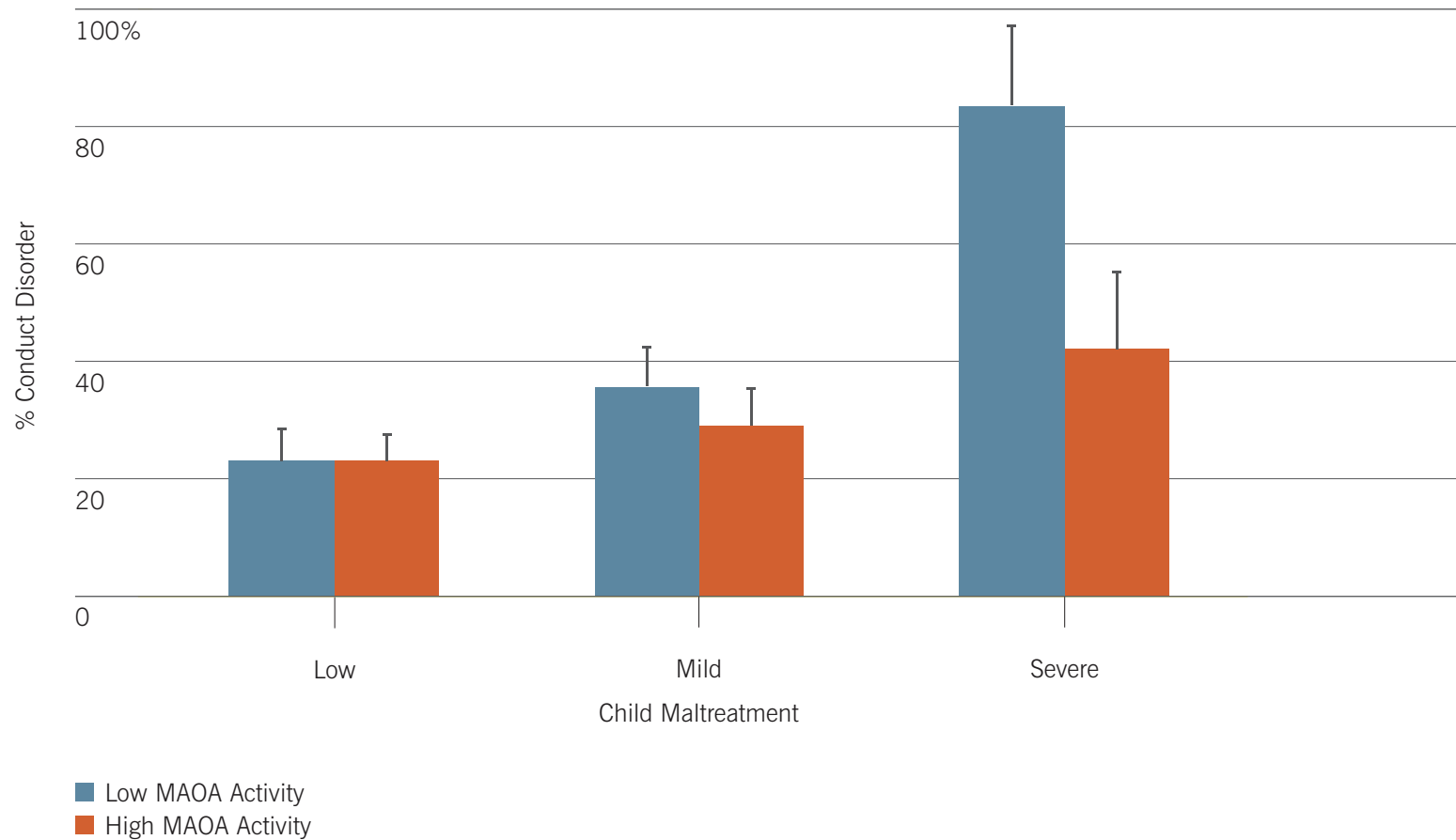
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Maternal Rejection	(14%)
Harsh Discipline	(10%)
Caregiver Changes	(6%)
Physical Abuse	(4%)
Sexual Abuse	(12%)



Source: Moffitt, "Gene-Environment Interaction in Problematic and Successful Aging," NIA Meeting Feb 12, 2008.

Male Conduct Disorder: Child Maltreatment Interacts with MAOA Genotype



Caspi, McClay et al. (2002).

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Sensitive and critical periods have been documented extensively for:

- Binocular vision in the cortex of mammals,
- Filial imprinting in the forebrain of ducks and chickens,
- Language acquisition in humans (Newport, 2002)

Critical and Sensitive Periods

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Sensitive and critical periods have been documented extensively for (*continued*):

- **Early vitamin/nutrient deficiencies can have substantial lasting negative effects on human development.**
- E.g., Iron; Vitamin A; Iodine
- Blindness, Impaired IQ, etc.
- Difficult to remediate at later ages

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Enriched Early Environments Compensate In Part For the Risks Arising from Disadvantaged Environments

- Main mechanism of intervention arises from noncognitive or personality investments.

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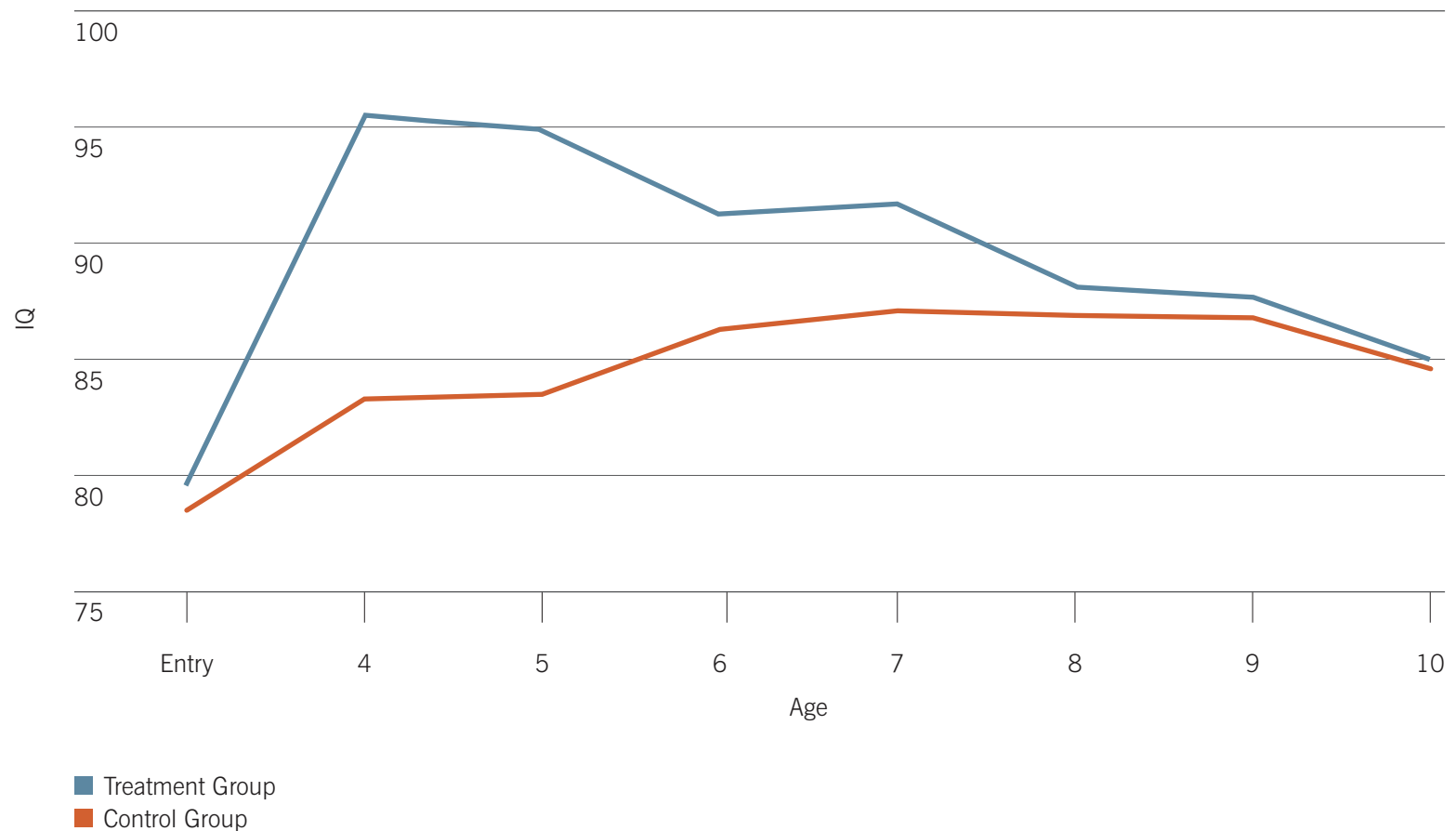
High/Scope Perry Preschool Program

High/Scope Perry Preschool Program

The Perry preschool program enriched the lives of low income black children with initial IQs below 85 at age 3.

- 2.5 hours per day
- 5 days per week
- 2 years during each school year (mid-October to May)
- Home visits
- Program stops after two years

Perry Preschool Program: IQ, By Age and Treatment Group



Source: Perry Preschool Program. IQ measured on the Stanford Binet Intelligence Scale (Terman & Merrill, 1960). Test was administered at program entry and each of the ages indicated.

High/Scope Perry Preschool Program

Yet has a statistically significant rate of return of around 7 – 10% per annum — for both boys and girls — above the post World War II stock market returns to equity in U.S. labor market estimated to be 5.8%.

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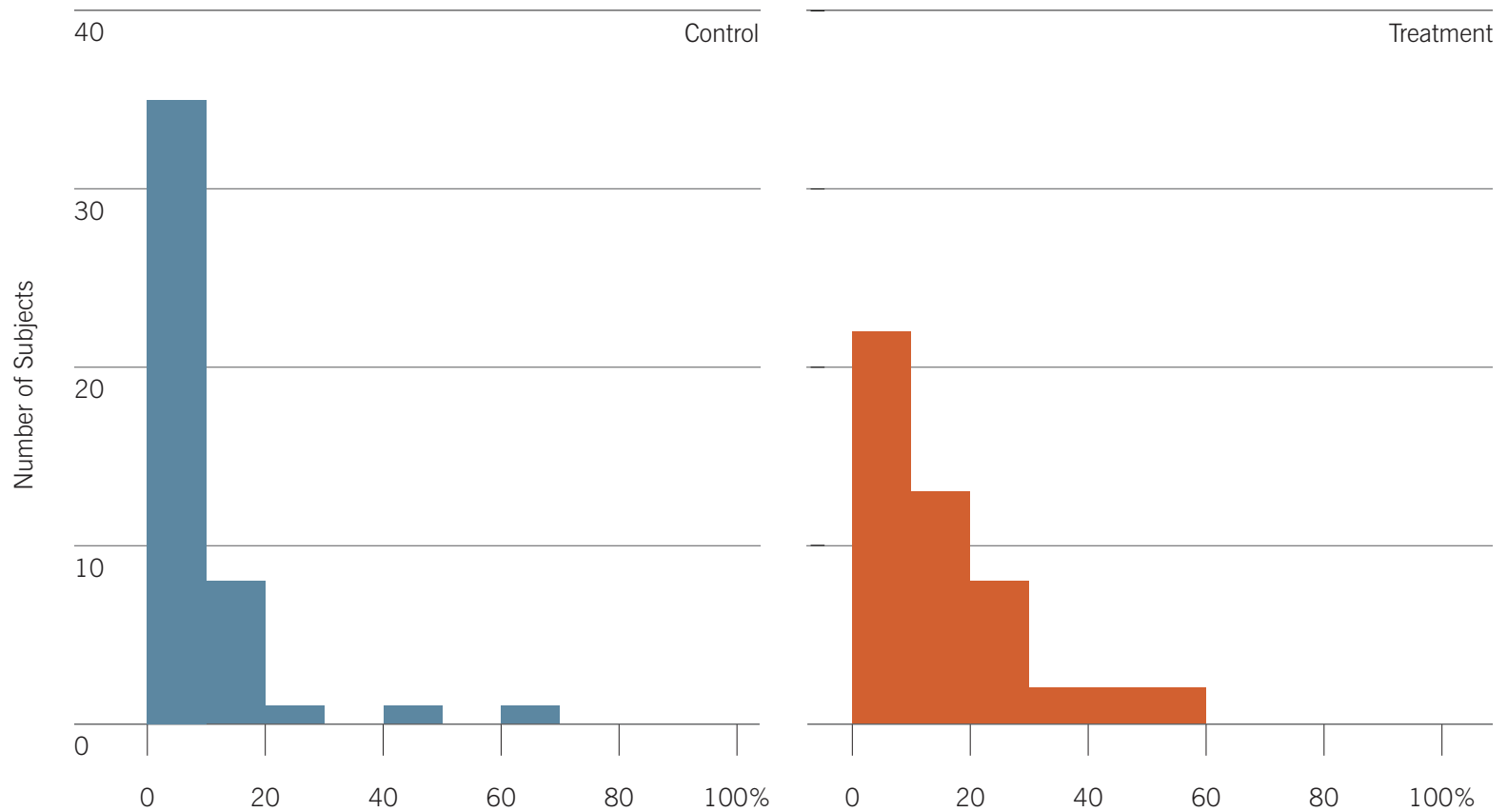
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Perry Age 14 Total CAT Scores, by Treatment Group



CAT = California Achievement Test

Treatment: N = 49; Control: N = 46

Statistically Significant Effect for Males and Females (p-values 0.009, 0.021 respectively)

Source: Heckman, Malofeeva, Pinto, and Savelyev (2008).

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Later Remediation is Costly and Often Ineffective

Later Remediation is Costly and Often Ineffective

As currently implemented, most adolescent remediation efforts, especially those targeted toward raising adolescent cognitive abilities targeted toward the disadvantaged have low returns.

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Later Remediation is Costly and Often Ineffective

For example:

- Active labor market programs
- Class size reductions (reducing class size by five pupils per classroom)
- Adult literacy programs
- Public job training programs
- Tuition reduction policy

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Data from non-controlled assessments of Head Start and the Chicago Child-Parent Centers programs suggest similar conclusions.

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The Abecedarian Program

The Abecedarian Program

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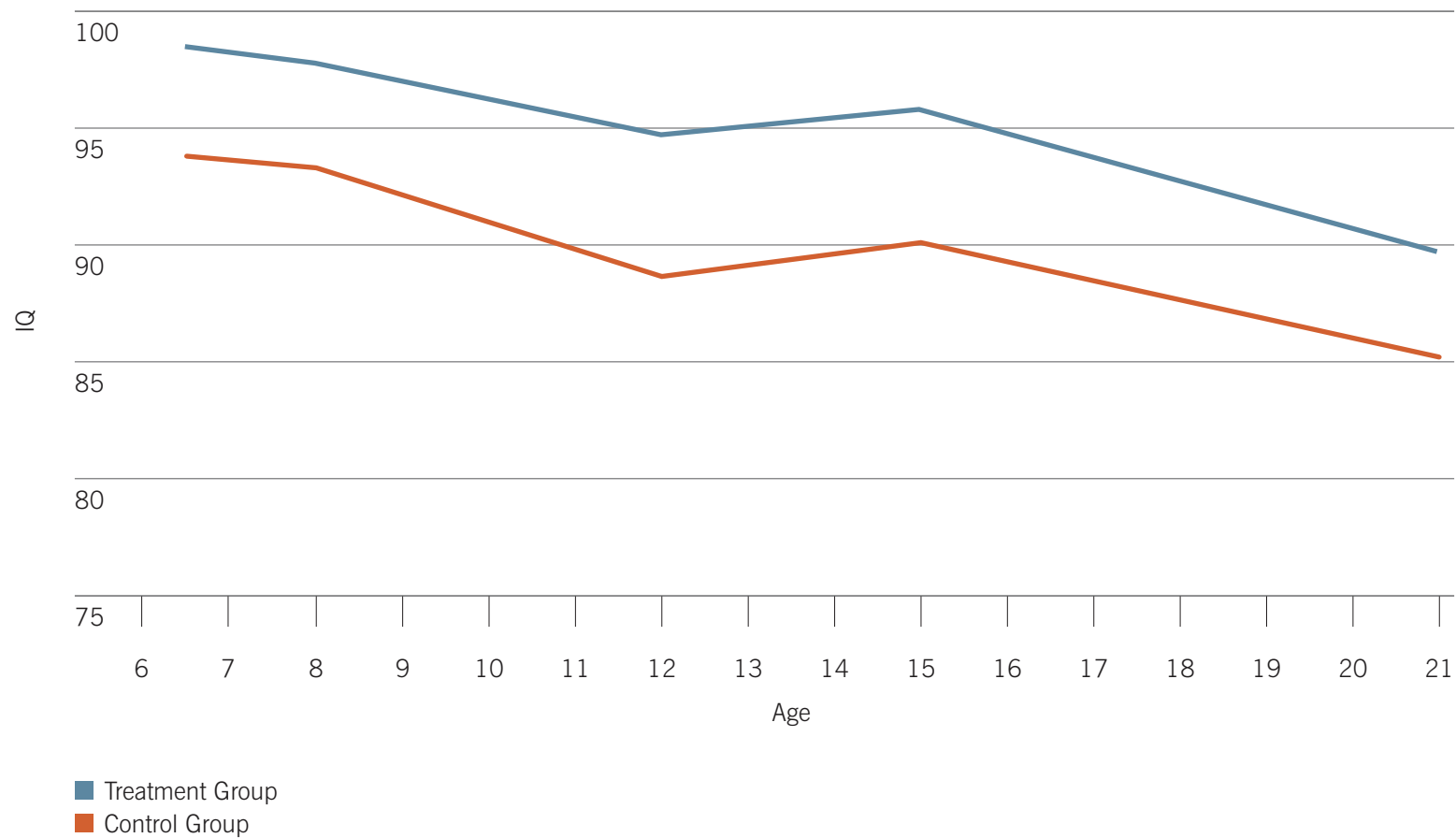
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Intervening at an early enough age can actually raise the IQ of the participants.

In the more intensive, earlier starting Abecedarian program, IQ gains were found.

Abecedarian Program: IQ, by Age and Treatment Group



Source: Barnett (2004).

The Abecedarian Program

Argument

Polarization

Skills

Abilities and
Outcomes

Explanations

Critical and
Sensitive
Periods

Circuits

Summary

Several observations about the evidence from the available intervention studies are relevant.

First, skills beget skills.

All capabilities are built on a foundation of capacities that are developed earlier.

The Abecedarian Program

Argument
Polarization
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Summary

This principle stems from two characteristics that are intrinsic to the nature of learning:

- Early learning confers value on acquired skills, which leads to self-reinforcing motivation to learn more,
and
- Early mastery of a range of cognitive, social, and emotional competencies makes learning at later ages more efficient and therefore easier and more likely to continue.

The Abecedarian Program

Argument

Polarization

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Outcomes

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Critical and
Sensitive
Periods

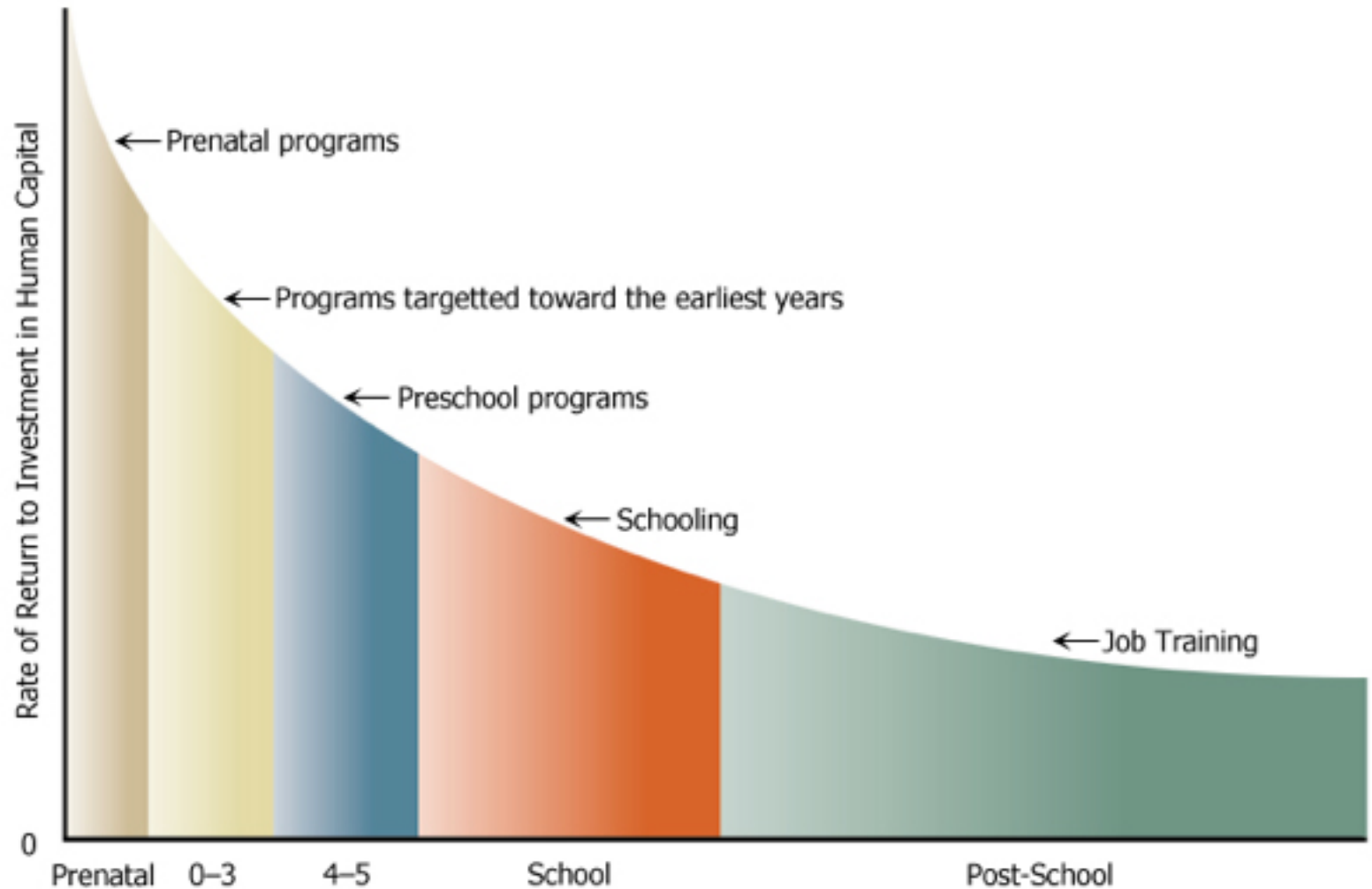
Circuits

Summary

Second, early intervention lowers the cost of later investment.

Public job training programs, adult literacy services, prisoner rehabilitation programs, and education programs for disadvantaged adults at current levels of expenditure produce low economic returns.

Figure 19: Returns to a Unit Dollar Invested



Source: Heckman (2008)

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Summary

Skills matter.

America has a skills problem. So do many other countries. Rising inequality is a signal of this problem.

American society is becoming polarized by education:

- More college graduates**
- More dropouts**

Summary

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Summary

More than smarts is required for success.

Social policy overemphasizes smarts.

Soft skills have been documented to be “hard” — we can measure them, and they are predictive.

Skill gaps emerge early and can be traced in part to adverse early environments.

Summary

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Summary

Schools and tuition do not matter as much as is often thought.

Late remediation not very effective.

Remediation can work, but is costly.

Social policy should be directed toward the malleable early years, if we want to successfully address these problems.